Diffusion tensor hepatic MR imaging with parallel imaging technique for the evaluation of focal hepatic lesions

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INTRODUCTION: Although measurement of apparent diffusion coefficient (ADC) by using single-shot echo-planar diffusion weighted imaging (DWI) may be useful in the detection and the characterization of focal hepatic lesions (1). Recently, parallel imaging technique can improve image quality of DWI in the liver by shortening echo time of sequences and data-sampling time. Moreover, parallel imaging technique allows employing adequate b value (more than 400 sec/mm^2) diffusion gradient without redundant signal loss of the liver. Based on such great advantages of parallel imaging technique in DWI, even Diffusion tensor imaging (DTI), which use additional gradients (more than six gradients) to plot the relative degree of diffusion in multiple dimensions, has been applying to the liver (2). DTI with parallel imaging may conduct more detailed imaging analysis for the diffusion phenomenon because DTI can provide information regarding not only amount of diffusion (ADC) but also anisotrophic direction of diffusion (fractional anisotrophy: FA). To our knowledge, there have no studies with a focus on the usefulness of DTI for evaluation of focal hepatic lesions and comparison of DTI with and without parallel imaging technique. The purpose of this study was to determine whether ADC and FA measurements obtained with DTI was useful for the characterization of focal hepatic lesions and whether a parallel imaging technique improved the accuracy of ADC and FA measurements on DTI.

MATERIALS AND METHODS: DTI was performed with a parallel imaging technique in 52 patients with 67 hepatic masses and without a parallel imaging technique in 41 patients with 45 hepatic masses. All DTI were obtained with 1.5-T superconducting MR units (Gyroscan Intera Nova dual, Philips medical systems). The each imaging parameters of DTI with a parallel imaging technique were as follows: TR/TE=1000/70, matrix=128x128, FOV=30x30cm, acquisition time=10sec, slice thickness/gap=7mm/0.7mm. Parallel imaging was performed using sensitivity encoding (SENSE). An acceleration factor of 2 was used. All DTI was conducted using a b value of 0 and 400. The diffusion gradients were applied in six directions for DTI. For the measurements of ADC and FA values, regions of interest were established in all hepatic lesions. ADC and FA values were calculated on each map created after the image acquisition using specific diffusion-analyzing software on the workstation.

RESULTS: The results of ADC and FA measurements with DTI without (Fig.1) and with (Fig.2) the parallel imaging technique, respectively. Benign, non-solid hepatic lesions showed significantly higher ADC values than did malignant, solid hepatic lesions on both DTI without ($p<.05$) and with ($p<.001$) the parallel imaging technique. For FA measurements, there were significant differences in FA values between benign and malignant hepatic lesions only on DTI with the parallel imaging technique (Fig.2). In addition, There was a tendency that the differences in both ADC and FA values between benign and malignant hepatic lesions were made larger on DTI with the parallel imaging technique (Fig.2) than on DTI without the parallel imaging technique (Fig.1). Although there was no significant difference between mean ADC value in cysts and it in necrotic metastases, mean FA value of necrotic metastases (over 0.42) was more larger than that of cysts (under 0.36).When combined threshold values for the differentiation between benign and malignant hepatic lesions were established at less than 1.62 x 10^{-3} mm^2/sec for ADC values and over 0.5 for FA values, sensitivity and specificity for the diagnosis of malignant hepatic lesions were 97% and 98%, respectively with this diagnostic criterion.

CONCLUSION: A combination of ADC and FA measurements with DTI were more useful than ADC measurements alone for differentiating between benign and malignant hepatic lesions. In addition, the parallel imaging technique improved such efficacy of DTI for the diagnosis of hepatic lesions.

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